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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/645,645	08/22/2003	Chandra Mouli	M4065.0674/P674	8786
24998	7590	02/14/2006	EXAMINER	
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP			KANG, DONGHEE	
2101 L Street, NW			ART UNIT	
Washington, DC 20037			PAPER NUMBER	
			2811	
DATE MAILED: 02/14/2006				

Please find below and/or attached an Office communication concerning this application or proceeding.

21

<b>Office Action Summary</b>	Application No. 10/645,645	Applicant(s) MOULI, CHANDRA	
	Examiner Donghee Kang	Art Unit 2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 24 March 2005.  
 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.  
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-54 is/are pending in the application.  
 4a) Of the above claim(s) 38-54 is/are withdrawn from consideration.  
 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
 6) ☒ Claim(s) 1-13 and 15-37 is/are rejected.  
 7) ☒ Claim(s) 14 is/are objected to.  
 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.  
 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) ☐ All b) ☐ Some \* c) ☐ None of:  
 1. ☐ Certified copies of the priority documents have been received.  
 2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)             | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 112***

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 15 & 28 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 25 & 28 recite the limitation "the transistor is a reset transistor" in lines 1-

2. There is insufficient antecedent basis for this limitation in the claim.

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-13, 16-27, & 29-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rhodes (US 6,232,626) in view of Tasumi (US 5,818,322).

Re claims 1, 4-6, 9-10, 16, 20-22, 25-26, 29-30, 32 & 35, Rhodes teaches a processor system, comprising (Fig.14):

a processor (444); and an image sensor (442) coupled to the processor, the image sensor comprising:

An array of pixel cells (Fig.4), at least one of the pixel cells comprising (Fig.5):

A photodiode (24, Col.10, lines 5-7); a gate of a transfer transistor adjacent to the photodiode; a floating diffusion region (30) electrically connected to the transistor; and readout circuitry (36 & 38) electrically connected to the floating diffusion region.

Rhodes does not teach the photodiode comprising layers of a Si and SiGe, wherein the layers are configured to promote ionization by a first carrier type and suppress ionization by a second carrier type. Tasumi teaches a superlattice structure of Si and SiGe is formed in the groove to form an avalanche photodiode. It is noted in the art that this avalanche photodiode promotes ionization by a first carrier type and suppress ionization by a second carrier type hence improving a light conversion efficiency. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute regular photodiode of Rhodes with avalanche photodiode as taught by Tasumi in order to improve photo converting efficiency of the photosensing element.

Re claims 2-3 & 37, Rhodes as modified by Tasumi does not explicitly teach a difference between the valence band energies of the Si layer and the SiGe layer is greater than a difference between the conduction band energies of the Si layer and SiGe layer. However, this feature is inherent in Rhodes as modified by Tasumi since same materials are used for photodiode.

Re claims 7-8 & 23-24, Rhodes as modified by Tasumi teaches the photodiode comprises at least four layers of Si and at least four layers of SiGe, wherein the layers of Si are alternated with the layers of SiGe to form an Si/SiGe structure, wherein at least

a first subset of layers is doped to a first conductivity type, and wherein at least a second subset of layers is doped to a second conductivity type.

Re claim 11, Rhodes as modified by Tasumi teaches at least a portion of the photodiode is at a level below the level of a top surface of the substrate.

Re claims 12 & 27, Rhodes as modified by Tasumi teaches the photodiode comprises 22 layers which is in the claimed ranges.

Re claim 13, Rhodes as modified by Tasumi does not each of the layers have a thickness of approximately 50 angstroms to approximately 300 angstroms.

It is an obvious matter of routine experimentation to find the optimal thickness ranges. Generally, difference in thickness will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such thickness is critical.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to select the thickness of the layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Re claim 17, Rhodes as modified by Tasumi teaches the photodiode is part of a CMOS image sensor.

Re claim 18, Rhodes as modified by Tasumi does teach the photodiode is part of a charge coupled device image sensor.

Re claim 19, Rhodes as modified by Tasumi teaches the substrate is a silicon-on-insulator substrate.

Re claim 31, Rhodes as modified by Tasumi teaches circuitry peripheral to the array, the peripheral circuitry being at a surface of the substrate, wherein the substrate is a silicon-on-insulator substrate.

Re claims 33-34, Rhodes as modified by Tasumi teaches  $\text{SixGe}_{1-x}$ , wherein x is 0.6.

#### ***Allowable Subject Matter***

5. Claim 14 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Prior art reference, taken along or in combination, do not teach or render obvious that the pixel comprising a graded buffer layer between a bottom layer of the photodiode and a surface of the substrate.

#### ***Conclusion***

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Donghee Kang whose telephone number is 571-272-1656. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Donghee Kang  
Primary Examiner  
Art Unit 2811

dhk